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Co-60 and Cancer Treatment: The Radiological Security Mission

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National Nuclear Security Administration
Office of Radiological Security
7 November 2016

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The risk of malicious use of radiological material requires action

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Threat types and motivations vary...

Homegrown Violent Extremists (HVEs)

Seven Sentenced In U.K. Terror Plot

Non-state actors

Insiders

Ex-Duke security expert charged in medical office break-ins

Posted April 8, 2011

CARY, N.C. — A former employee of the Duke University Police Department has been charged in a string of burglaries at medical offices from Durham to Clayton, police said Friday.

Cary police arrested Shawn Michael Flaugher, 36, at his home on Gray Ghost Street in Benson on Thursday and charged

Lone-wolves

Report: 'Dirty bomb' parts found in slain man's home

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By Walter Griffin
Posted Feb. 10, 2009, at 10:22 p.m.

BELFAST, Maine — James G. Cummings, who police say was shot to death by his wife two months ago, allegedly had a cache of radioactive materials in his home suitable for building a "dirty bomb."

According to an FBI field intelligence report from the Washington Regi... Threat and Analysis Center posted online by WikiLeaks, an organiz... posts leaked documents, an investigation into the case revealed t... materials were removed from Cummings' home after his shoot... 9.

The report posted on the WikiLeaks Web site states tha...

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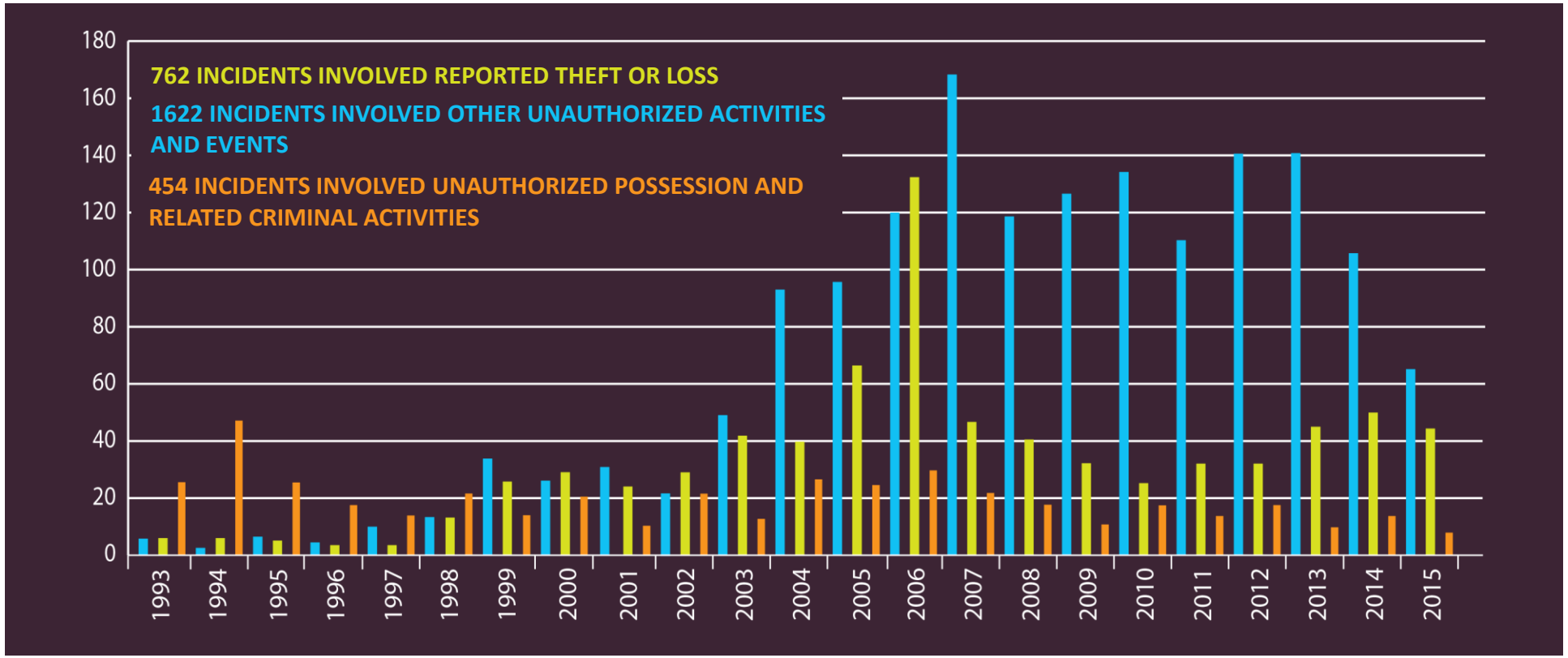
…and there are many documented incidences of radiological/nuclear material diversion.



"As of 2015, the IAEA counted 2889 confirmed incidents reported by the 131 participating states"

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Accidents: dispersed radioactive material has created large scale consequences.

Recovery of Co-60 pencils from a scrapped teletherapy unit in India

Goiania cleanup activities.

NYC Dispersion Analysis

<u>Delhi, India:</u> Eight people hospitalized, one subsequently died

<u>Goiania:</u> 40 tons of rad-waste from a 3.3 oz. source

<u>NYC RDD Analysis:</u> Relocation area 18 km²

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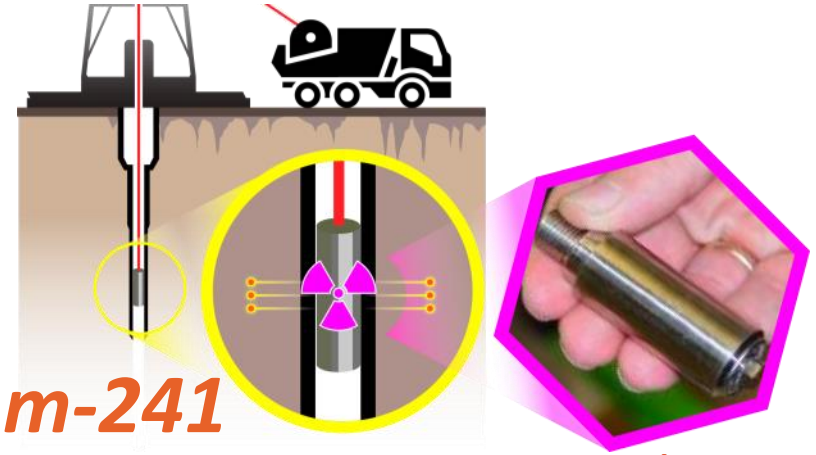
High activity sources are commonly used in medical and industrial applications.

- Teletherapy and Gamma Knife units (cancer treatment)
- Self-shielded and panoramic irradiators (research and sterilization)

Co-60

Normal Device Activity
1,000 – 1,000,000+ Ci



Am-241

Normal Device Activity
8-20 Ci

Oil well logging (industrial imaging)

Ir-192

Radiography (industrial imaging)

Normal Device Activity
10-100 Ci

Cs-137

Normal Device Activity
1,000 – 50,000 Ci

- Self-shielded irradiators (research and sterilization),
- brachytherapy (cancer treatment),
- calibrators (dosimeter and detector calibration)

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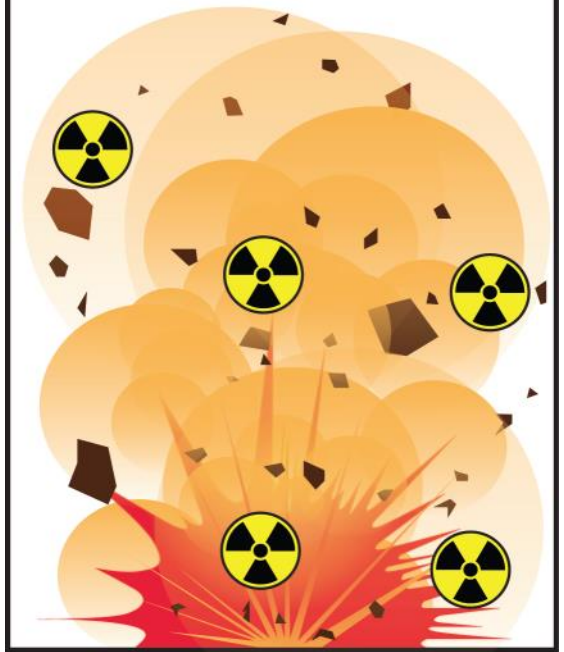
And these sources can be used in different types of attacks.

Rad Dispersal



Radiological Dispersal Devices *create contamination by disseminating radioactive materials.*

Radiological Exposure Devices *Emit high doses of radiation but doesn't create contamination. Injury mechanism is direct exposure.*

Rad Exposure

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RDD Materials are relatively easy to obtain because they can be found in many locations.

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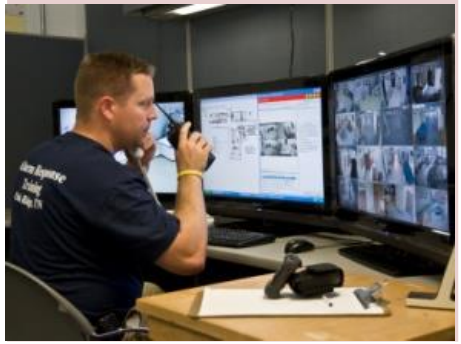
DOE/NNSA Office of Radiological Security

MISSION: The Office of Radiological Security enhances global security by preventing high activity radioactive materials from use in acts of terrorism.

PROTECT

PROTECT radioactive sources used for vital medical, research, and commercial purposes



REMOVE

REMOVE and dispose of disused radioactive sources

REDUCE

REDUCE the global reliance on high-activity radioactive sources by promoting the adoption and development of non-isotopic alternative technologies

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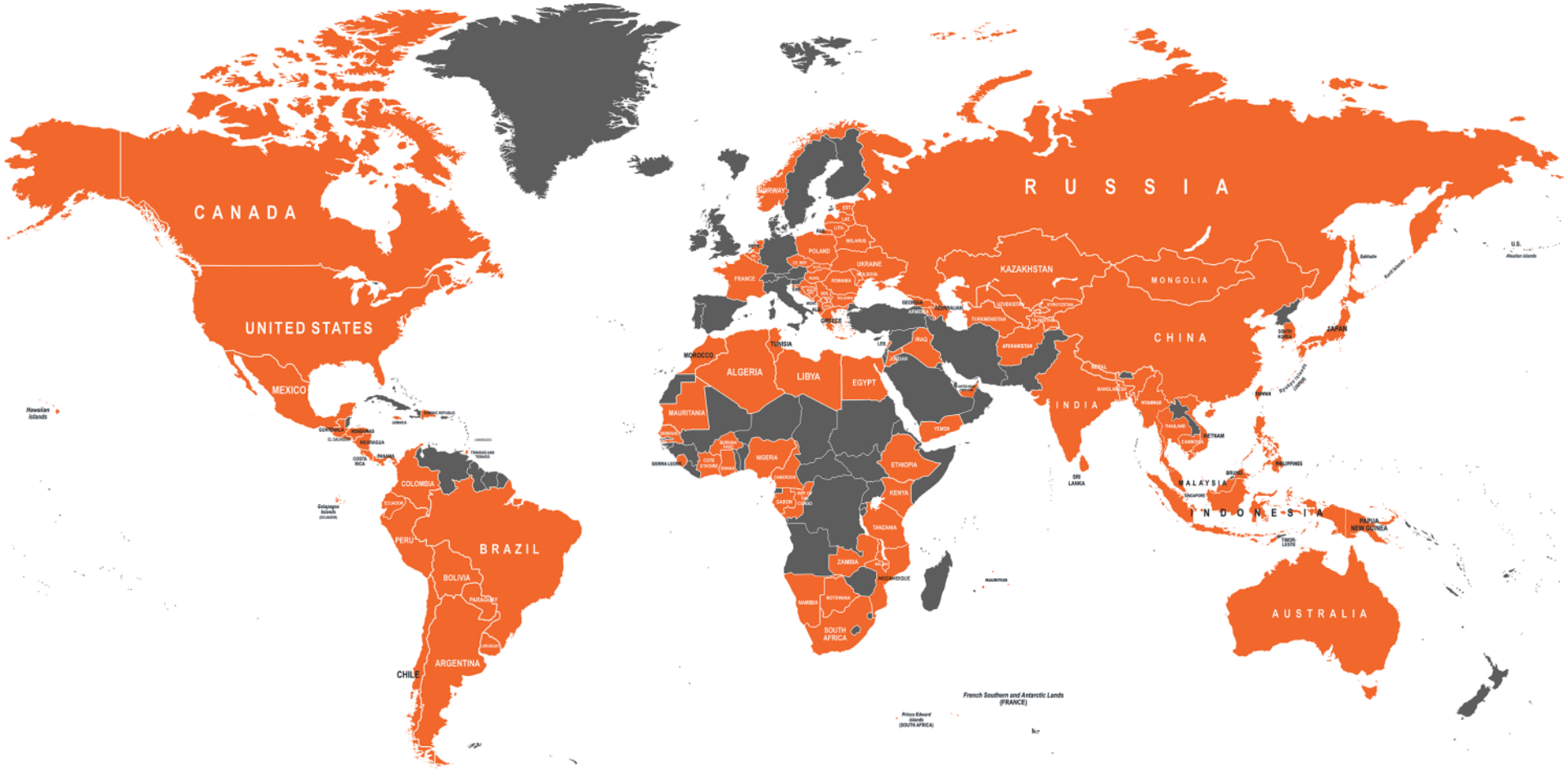
ORS Global Partners



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GLOBAL PARTNERS
December 2015

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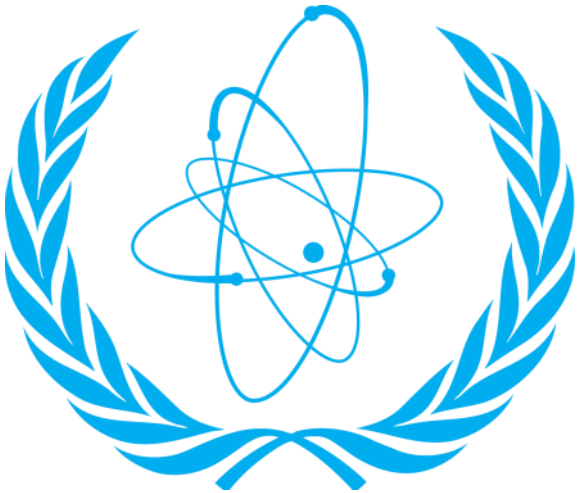
The global community is committed to addressing radiological risk

UNSCR 1540: Countering WMD Proliferation
UNSCR 1373: Preventing and Suppressing Terrorist Acts



International Atomic Energy Agency
Code of Conduct on Safety and Security of Sources

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REDUCE: Alternative Technologies

Reduce initiative seeks to convert and replace radiological devices with non-radioactive source-based devices, where feasible, and achieve permanent risk reduction by reducing the footprint of risk-significant radiological materials

Application	Typical Isotope	Commercially Available Alternatives?
Blood Irradiation	Cs-137	Yes: X-ray—2 FDA approved devices Partial: UV Pathogen Reduction—FDA approval for platelet & plasma systems, ongoing R&D for red blood cell systems
Research Irradiation	Cs-137 Co-60	Partial: X-ray Irradiators for most research applications
External Beam Radiotherapy	Co-60	Yes: Medical Linear Accelerators (LINACs)
Industrial Sterilization	Co-60	Yes: X-Ray, E-beam, LINACs
Well Logging	Am-241 & Cs-137	Incomplete: Am-241 - alternatives available, Cs-137 – ongoing R&D
Radiography	Ir-192	Yes: X-ray

Commercially available, non-isotopic alternatives exist for most major applications of high activity radioactive materials.

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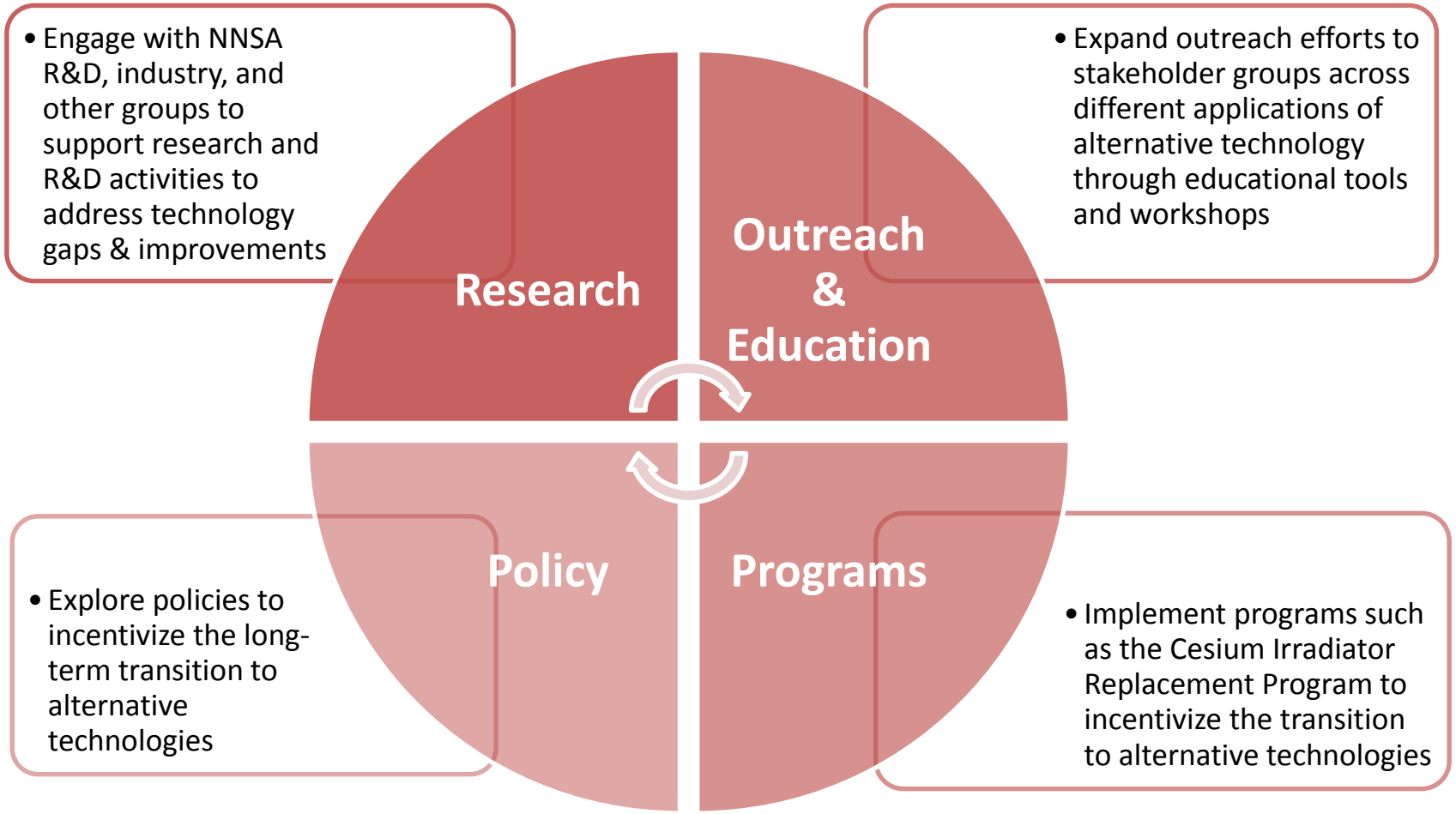
NNSA Strategic Approach



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Global Momentum/Nuclear Security Summit 2016

- **Joint Statement** on Strengthening the Security of Radioactive Sources
- **U.S. National Statement – 2016**
  - Commitment to replace 34 blood irradiators by 2020
- **Alternative Technology References**
  - IAEA Action Plan
  - Global Partnership Action Plan
  - Nuclear Industry Summit
  - Federation of American Scientists, Nobel Laureates Letter
- **National Statements and Progress Reports**
- **Upcoming Meetings – December IAEA Nuclear Security Conference**

HASS Signatories (28+1)

Australia, Belgium, Canada, Chile, China, Czech Republic, Denmark
Finland, France, Germany, Hungary, Israel, Italy, Kazakhstan, Lithuania, Morocco, Netherlands, Norway, Poland, Republic of Korea, Romania, Singapore, Spain, Sweden, Switzerland, Thailand, United Kingdom, United States, Interpol

National Progress Reports

Denmark
Finland
France
Germany
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Norway
Sweden
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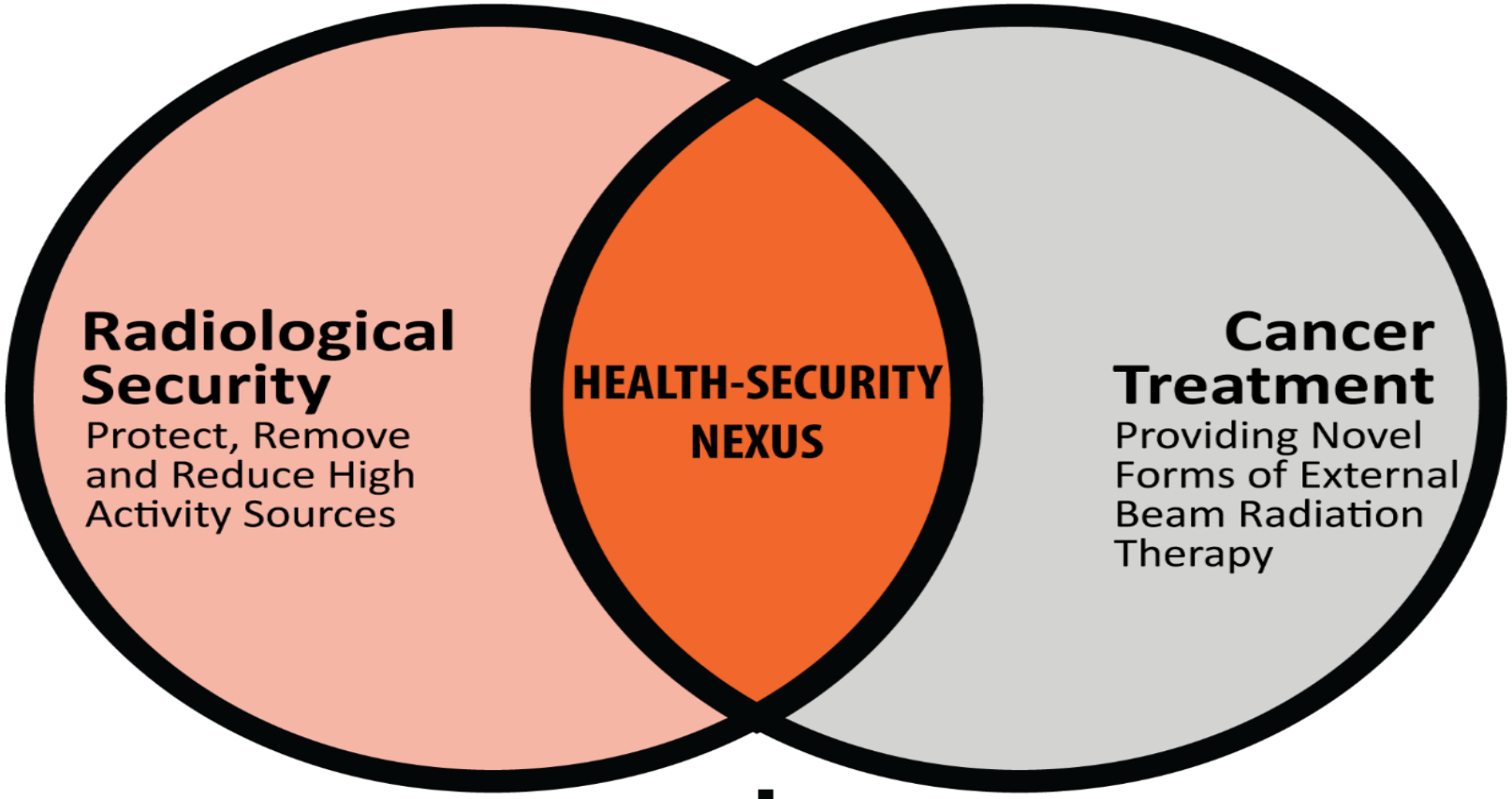
Sustainable Health & Security Solutions



Technology & Equipment + Training & Expertise + Mentoring & Network

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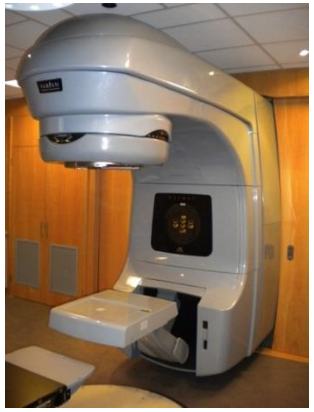
External Beam Radiotherapy

Medical Linear Accelerators (LINACs) and Cobalt-60 (Co-60) teletherapy or Co-60 based stereotactic radiosurgery devices are used to deliver external radiotherapy, an important cancer treatment mechanism. Approximately 60% of patients with cancer will receive radiotherapy.

Cobalt-60 teletherapy

Cobalt-60 based stereotactic radiosurgery



Linear Accelerator: Can be used in most cases for both standard external beam radiotherapy treatment and stereotactic radiosurgery

The CyberKnife is a radiosurgery LINAC that can treat tumors throughout the body

All technologies shown are FDA approved

User Considerations for Replacement

- **Cost** and **Implementation**
  - Capital costs, Warranty & Maintenance contracts, infrastructure modifications, etc.
- **Reliability**
  - LINACs generally require more frequent maintenance and experience more down-time
- **User/patient availability & accessibility**
  - Radiotherapy travel and cost requirements are prohibitive to many patients
- **Training & ongoing education** for clinical and maintenance personnel
- **Technology differences for certain treatments**
  - Some debate about LINAC efficacy for Stereotactic Radiotherapy
- **Timeline** – e.g., financing, disposition, manufacturer installation

Co-60 Source Lifecycle Management

Why is it important to consider disposition?

- Incomplete or improper source disposition increases the risk of a radiological theft or accident.
- Many sites lack access to the funds and/or technical expertise required to disposition unwanted teletherapy units and sources, resulting in long-term on-site storage of disused Co-60.
  - May result in orphaned sources.

It is important that source users adhere to State regulations and guidance on safe and secure management of disused sources.
Best practices are identified in the IAEA Code of Conduct on the Safety and Security of Radioactive Sources
(http://www-ns.iaea.org/tech-areas/radiation-safety/code-of-conduct.asp)

Global Momentum

Globally, many countries have wholly or partially transitioned to non-radioactive source-based alternative technologies.

- Co-60 Teletherapy Units to Linear Accelerators
- Cs-137 Blood Irradiation to X-ray Blood Irradiation or UV pathogen reduction systems

NNSA is supporting increased information-sharing and dialogue on alternative technologies through several international and multilateral venues.

- International Meeting on Radiation Processing – Vancouver (Nov 2016)
- IAEA Ad Hoc Meeting of Stakeholder States Involved with Technological Alternatives to High-Risk Radioactive Sources (Third Mtg Spring 2017)
- IAEA 2016 Nuclear Security Conference, Technical Session on Alternative Technologies (8 Dec 2016)
  - World Institute of Nuclear Security side event on alternative technologies (7 Dec 2016)